

11/24/97
10556 U.S. PTO

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I HEREBY CERTIFY THAT THIS PAPER OR FEE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE "EXPRESS MAIL POST OFFICE TO ADDRESSEE" SERVICE UNDER 37 CFR 1.10 ON THE DATE INDICATED ABOVE AND IS ADDRESSED TO: ASSISTANT COMMISSIONER FOR PATENTS, WASHINGTON, DC 20231.

TYPED NAME Stephen E. Baldwin, Reg. No. 27,769

SIGNED

DATE 11/24/97

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

This is a request for filing a

☐ Continuation

☐ Continuation-in-Part (supplemental declaration required; see item 10)

☒ Divisional

application under 37 C.F.R. 1.60 of pending application Serial No. 08/773,555 filed on December 27, 1996 which is a continuation-in-part of prior application Serial Number 08/513,573 filed on August 10, 1995, now U.S. Patent 5,656,985, in the name Peter Lu, Jeffrey Heaton, James W. Heaton Peter Loh Hang Pao, Robert Loke Hang Lam, and Tsang Kei Sun for ELECTRONIC SURFACE MOUNT PACKAGE (Title of Invention).

1. ☒ Enclosed is a copy of the prior application, including the oath or declaration, as originally filed. (See 9(a) and (b) for drawing requirements.)
2. (a) ☐ Enclosed is a Small Entity Affidavit.
(b) ☒ A Small Entity Affidavit is of record in the prior application.

3. X The filing fee is calculated below:

Claims remaining in the application after entry of any amendments under 37 C.F.R. 1.116 unentered in the prior application and less any claims canceled by amendment below:

	(Col. 1)	(Col. 2)	<u>SMALL ENTITY</u>			<u>OTHER THAN A SMALL ENTITY</u>	
FOR:	<u>NO. FILED</u>	<u>NO. EXTRA</u>	<u>RATE</u>	<u>FEE</u>	OR	<u>RATE</u>	<u>FEE</u>
BASIC FEE				\$395	OR		\$790
TOTAL CLAIMS	<u>7</u> -20 = *	<u>0</u>	x11 =	\$ <u>0</u>	OR	x22 =	\$ <u> </u>
INDEP CLAIMS	<u>3</u> - 3 = *	<u>0</u>	x41 =	\$ <u>0</u>	OR	x82 =	\$ <u> </u>
[0] MULTIPLE DEPENDENT CLAIM PRESENTED			+135 =	\$ <u>0</u>	OR	+270 =	\$ <u> </u>
*If the difference in Col. 1 is less than zero, enter "0" in Col. 2.			TOTAL	<u>\$395.00</u>	OR	TOTAL	\$ <u> </u>

4. The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 20-1497 (Order Halo-012). Two copies of this sheet are enclosed.

5. Our Check No. in the amount of \$ is enclosed.

6. X Cancel in this application original claims 8-13 of the prior application before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)

7. X Amend the specification by inserting before the first line the sentence:

--This is a continuation, continuation-in-part, X divisional of pending application Serial No. 08/773,555 filed on December 27, 1996 which is a continuation-in-part of prior application Serial Number 08/513,573 filed on August 10, 1995, now U.S. Patent 5,656,985.--

8. Enter the amendments under 37 C.F.R. 1.116 filed on unentered in the prior application.

9. (a) 6 sheets of Informal drawings are enclosed.

(b) sheets of Formal drawings are enclosed.

10. A preliminary amendment is enclosed. (Claims added by this amendment have been properly numbered consecutively beginning with the number next following the highest numbered original claim in the prior application.)

- 11.(a) _____ Priority of application Serial No. _____ filed on _____ in
_____ is claimed under 35 U.S.C. 119.
- (b) _____ The certified copy has been filed in prior application Serial
No. _____ filed on _____.
12. x The prior application is assigned of record to Halo Electronics,
Inc.
13. X The power of attorney in the prior application is to:

TRIAL & TECHNOLOGY LAW GROUP
A Professional Law Corporation
545 Middlefield Road, Suite 220
Menlo Park, California 94025

- (a) X The power appears in the original papers in the prior
application.
- (b) _____ Since the power does not appear in the original papers, a
copy of the power in the prior application is enclosed.
- (c) _____ A new power has been executed and is enclosed.
- (d) _____ Address all future communications to:

TRIAL & TECHNOLOGY LAW GROUP
A Professional Law Corporation
545 Middlefield Road, Suite 220
Menlo Park, California 94025

14. _____ A preliminary amendment and Rule 132 declaration will be submitted
when formal filing receipt is received.

15. X I hereby verify that the attached papers are a true copy of prior
application Serial No. 08/773,555 as originally filed on December 27, 1996.

Date: 11/24, 1997

Signature: 
Stephen E. Baldwin
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Inventor(s)

Assignee of complete interest

X Attorney or agent of record

Filed under Section 1.34(a)

PATENT

Docket No.: Halo-003

ELECTRONIC SURFACE MOUNT PACKAGE

By: Peter Lu
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James W. Heaton
Tsang Kei Sun
Peter Loh Hang Pao
Robert Loke Hang Lam

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part of copending application entitled ELECTRONIC SURFACE MOUNT PACKAGE, Serial No. 08/513,573, filed August 10, 1995 and assigned to the same Assignee as the present application.

BACKGROUND OF THE INVENTION

The present invention relates to an electronic surface mount package or case. Electronic surface mount packages are utilized in applications in which one or more individual toroid transformers are embodied within the surface mount package.

Wires coming off the transformers are electronically tied to pins on the package for connection to an electronic device. Typically, the electronic surface mount packages are mounted on a printed circuit board for utilization in the electronic device.

It is widely known in the local area magnetic industry that when surface mount toroidal magnetics which are encapsulated in hard plastics go through infra-red soldering processes, the magnetic components (ferrite) can expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which makes the part unusable. In view of the foregoing, it would be highly desirable to provide an improved electronic surface mount package which avoids the cracking and expansion problems described above.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved electronic surface mount package.

Briefly, according to one preferred embodiment, the present invention provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound and soldered. The wire which is wound and soldered around each terminal pin/post is from a respective toroid transformer carried within the package. Each of the posts are notched so that the respective wires are separated from one another so as to avoid arcing. The case is open at the bottom which prevents cracking and allows for the toroidal expansion. The present invention also includes a reinforcement beam that is disposed laterally or sidewise across the bottom of the package to provide extra

support in the mechanical strength of the case.

Other objects, features, and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention:

Figure 1 shows an electronic surface mount package in three-dimensional view according to the present invention.

Figure 2 shows a wound toroid transformer.

Figure 3 shows the connection of the toroid transformer of Figure 2 within the electronic surface mount package of Figure 1.

Figure 4 shows the electronic surface mount package of Figure 1 after wire terminations have been soldered.

Figure 5 and 6 show relationships between a safeguard (standoff) and the electronic surface-mount package's foot seating plane and inner terminal posts, respectively.

Figure 7 shows a close-up of the pin configuration of Figure 1 and how it is molded inside the wall of the body of the package.

Figure 8 shows wire wrapped around the pin or post of

Figure 7.

Figures 9A -9D show end, top, side, and bottom views of electronic surface mount package according to the present invention.

Figure 10 shows a bottom view of a 40 pin package according to the present invention.

Figure 11 shows an enlarged sectional view of Figure 10 illustrating a reinforcement beam.

DETAILED DESCRIPTION OF THE DRAWINGS

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings, where like numerals indicate like components. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to those embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.

As will be described in more detail below, the present invention is directed toward applications for packages mounted on a printed circuit board in an electronic device, which requires very low current and voltages, and is for DC voltages only. The

present invention provides for a low power application in which the package includes one or more toroidal transformers which are carried or supported by a soft silicon type material within an open construction package and which utilizes a portion of the case as a standoff to ensure that the pin-posts do not touch a PCB when mounted by a user.

As described above, it is known that when the parts go through an infra-red soldering process, the magnetic components (ferrite toroids) can expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which is highly undesirable. The present invention solves this problem by providing an open design within which is placed a soft silicon type material which allows for expansion during the soldering process, rather than trying to contain the components within a closed case or package. Hence, with the open construction, the present invention has no bottom at all. In addition, the magnetic components are not mounted on anything but rather are encapsulated or supported ("carried by a soft silicon type material"). The wires from the toroids are wound around and soldered to the pin-posts. This construction solves the cracking and expansion problems described above, as will now be described in conjunction with Figures 1-11.

Figure 1 shows an electronic surface mount transformer package or case 10 in three-dimensional view. Figure 1 shows a cut-away of the empty case 10 with pins 14 molded into the case

10, together a the notched post 12 upon which a wire is wound. Post 12 has an hour-glass shape which facilitates the winding of wire around post 12, as will be described. Typically, tin-lead plated copper alloy terminals are molded into the wall of the package 10. The outer portion of the package 10 is formed to meet specified footing requirements. The inner post 12 serves as a terminal for internal wire termination use. The package material is made of type of thermal plastic which is in compliance with UL V-94 requirement for flammability.

Figure 2 shows a wound toroid transformer 20 with wire 22 wrapped around the transformer 20. The toroid core is typically made of ferrite material and the winding of wire 22 is done manually with fine insulated magnet wire.

Figure 3 shows a cut-away of the molded part with the toroid 20 mounted inside and showing the wire 22 as it is then attached to post 14. The wires 22 are pulled with minimum tension and wrapped around the terminal post 14 for two to two and a half turns. This operation is done when the case has been placed bottom side up.

Figure 4 shows a silicon compound 30 poured inside the cavity with wire terminations that have been soldered with high temperature solder (95 Ag/5Sn) 32 and the package has been properly cleaned. The case 10 is then filled with soft silicone material (preferably a soft epoxy type material) to protect the transformer and to meet environmental requirements.

Figures 5 and 6 show the relationships between the safe

guard (stand off) 34 and package's foot seating plane and inner terminal posts 12a. Figure 5 shows the standoff 34, in which the parts typically are placed automatically by machine onto a PC board. They are pressed down, as it is desirable to have some limitation of how far they can be pressed. It is also desirable that the post 12 does not touch the PC board, and so the end standoffs 34 do not allow that to happen. In a preferred embodiment, post 12 is oriented substantially perpendicular to, but does not touch, PC board.

Figure 6 shows the distance in relationship between the end of the post 12 and where the PC board 36 is located and also where the standoff 34 ends. The PC board 36 would be at the base of the foot.

In Figure 6, the typical clearance of 0.015 inches from the safe guard 34 to the seating plane is to avoid interference to the coplanarity of the package. There is also a gap between the safe guard 34 and terminal post 12 to prevent the solder joints from touching the circuit board due to an over forced pick and place operation.

Inside the package 10, there may be two, three, or more individual toroidal transformers. Wires coming off of the transformers are connected to the outside world. For example, the pins may be mounted on a printed circuit board in an electronic device. The leaf frame pins are injection molded into the body and which allows for an exposed notched post upon which the wire is wound from the toroidal transformer. This allows for

the wires to be separated from pin to pin, and for soldering to be much more efficient.

Figure 7 shows a closeup of the hour-glass shaped pin 12 and how pin 12 is molded inside the wall of the body and also the notch effect 40 of the pin 12. The post 14 is notched so that the wires are kept away from another, post to post, which is very desirable. The separation is desirable so as to avoid arcing.

Figure 8 shows the wire 22 wrapped around the pin or post 12.

Figures 9A-9D show end, top, side, and bottom views, respectively, of the electronic surface mount package 10. The embodiment shown in Figures 9A-9D provide an industrial standard surface mount footprint and package dimensions which are auto pick and placeable. In addition, special design consideration has been applied to thermal expansion of materials to ensure that the package will stand all normal re-flow processes with low cost, easy manufacturing, and high reliability.

In the industry, most manufacturers have used a two-piece construction, a base and a cover, and the case is backfilled with hard epoxy. In some processes, the coefficients of expansion of the epoxy that has been backfilled tends to cause the two pieces to separate. The base separates from the top, and as a result, can end up cracking. The present invention provides a one-piece open construction (an open bottom) only with the soft silicon filling to protect the toroid. The case is open at the bottom, thus allowing the toroids to expand naturally without cracking

the body of the part.

Figure 10 shows a bottom view of a 40 pin package 30 which includes pins 32 which includes a reinforcement beam 36 laterally disposed across the bottom of the case or package 30 reinforcement beam 36 provides extra support for improving the mechanical strength of the package 30.

Figure 11 shows an enlarged sectional view of the package 30 of Figure 10 in which the reinforcement beam 36 is disposed laterally or sidewise across the bottom of the package or case 30. The 40 pin surface mount package shown in Figures 10 and 11 include the reinforcement beam 36 which provides extra support to the mechanical strength of the package 30. This provides for an improved mechanically stable package 30 which when undergoing an IR (infrared) re-flow process and also maintain the coplanarity of the leads or pins 32 shown in Figure 11.

Although Figure 11 shows one reinforcement beam 36 laterally disposed across the bottom of the case or package 30, it would be apparent to one of ordinary skill in the art that additional reinforcement beams can be located on the bottom of the case or package 30 as the situation warrants.

It should become apparent that various desirable features of the present invention have been shown and described. In the present invention, the pin termination is not flush mounted but rather extends from the bottom of the package. Further, the termination is wound and soldered to the extended pin-post assembly, as shown in Figures 1 and 3-8. The use of a soft

silicon type material (such as soft epoxy) to carry the toroid transformers within the case or package acts to encapsulate or support the toroid transformer within the case or package.

The present invention is directed toward applications for packages mounted on a printed circuit board in an electronic device, which requires very low current and voltages, and is for DC voltages only. The present invention provides for a low power application in which the package includes one or more toroidal transformers which are carried or supported by a soft silicon type material within an open construction package and which utilizes a portion of the case as a standoff to ensure that the pin-posts do not touch a PCB when mounted by a user.

It is widely known that when the toroidal magnetics are mounted in hard plastic packages, the infra-red soldering processes cause the magnetic components (ferrite) to expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which is highly undesirable. The present invention solves this problem by providing an open design within which is placed a soft silicon type material which allows for expansion during the soldering process, rather than contain the components within a closed case or package. Hence, with the open construction, the present invention has no bottom at all. In addition, the magnetic components are not mounted on anything but rather are encapsulated or supported ("carried by a soft silicon type material") such that when the wires are wound

around and soldered to the pin-posts, the cracking and expansion problems described above are avoided. ✓

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and it should be understood that many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.

WHAT IS CLAIMED IS:

1. An electronic surface mount package comprising:
a one piece construction package having an open bottom,
a plurality of toroid transformers carried within said package, said toroid transformers each having wires wound thereon,
a plurality of terminal pins molded within said package, each of said pins having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively, and
at least one reinforcement beam located laterally along the bottom of said package to provide improved mechanical strength of said package.
2. An electronic surface mount package comprising:
A construction package having an open bottom,
a plurality of toroid transformers carried within said package, said toroid transformers each having wires wrapped thereon,
a plurality of terminal pins molded within said package, each of said pins having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively, and
at least one reinforcement beam located laterally along the bottom of said package to provide improved mechanical

strength of said package.

3. A package as in Claim 2 wherein said construction package is one piece.

4. The package of Claim 3 wherein said construction package has an open bottom.

5. The package of Claim 4 wherein said posts are separated from one another so as to avoid arcing.

6. An electronic surface mount package for mounting on a printed circuit board in an electronic device, said electronic surface mount package comprising:

a one piece construction package,

a plurality of toroid transformers carried within said package, said toroid transformers each having wires wound thereon,

a plurality of terminal pins molded within said package, each of said pins having a notched post upon which said wires from some transformers are wrapped and soldered thereon, respectively, and

at least one reinforcement beam located laterally along the bottom of said package to provide improved mechanical strength of said package.

7. The package as in Claim 6 further including a standoff for maintaining a distance between said terminal pins and said printed circuit board.

8. An electronic surface mount package for mounting on a printed circuit board in an electronic device, said package comprising:

a one piece open construction package,

a plurality of toroid transformers carried within said package, said toroid transformers each having wires wound thereon,

a plurality of terminal pins molded within said package, each of said pins having a hour-glass shaped notched post upon which said wires from said transformers are wrapped thereon, respectively.

9. An electronic surface mount package comprising:

- a one piece open construction package,
- a plurality of toroid transformers carried within said package by a soft silicon type material, said toroid transformers each having wires wound thereon,
- a plurality of terminal pins molded within and extending from the bottom of said package, each of said pins having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively.

10. An electronic surface mount package comprising:

- a construction package having an open bottom,
- a plurality of toroid transformers carried within said package by a soft silicon type material, said toroid transformers each having wires wound thereon,
- a plurality of terminal pins molded within said package, each of said pins having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively.

11. An electronic surface mount package for mounting on a printed circuit board in an electronic device, said electronic surface mount package comprising:

a one piece open construction package,

a plurality of toroid transformers carried within said package by a soft silicon type material, said toroid transformers each having wires wound thereon,

a plurality of terminal pins molded within said package, each of said pins having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively.

12. The package as in Claim 11 further including a standoff for maintaining a distance between the bottom of said pins and said printed circuit board.

13. An electronic surface mount package comprising:

an open construction package,

at least one toroid transformer carried within said package by a soft silicon type material, said toroid transformer having a wire wound thereon,

at least one terminal pin molded within said package, said pin having a notched post upon which said wire from said transformer is wrapped and soldered thereon.

ABSTRACT OF THE DISCLOSURE

An electronic surface mount package provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound which is from a toroid transformer carried within the package. Each of the posts are notched so their respective wires are separate from one another so as to prevent arcing. The case is opened at the bottom which prevents harm from expansion or cracking. A reinforcement beam is located laterally across the bottom of the package to provide mechanical strength for the case.

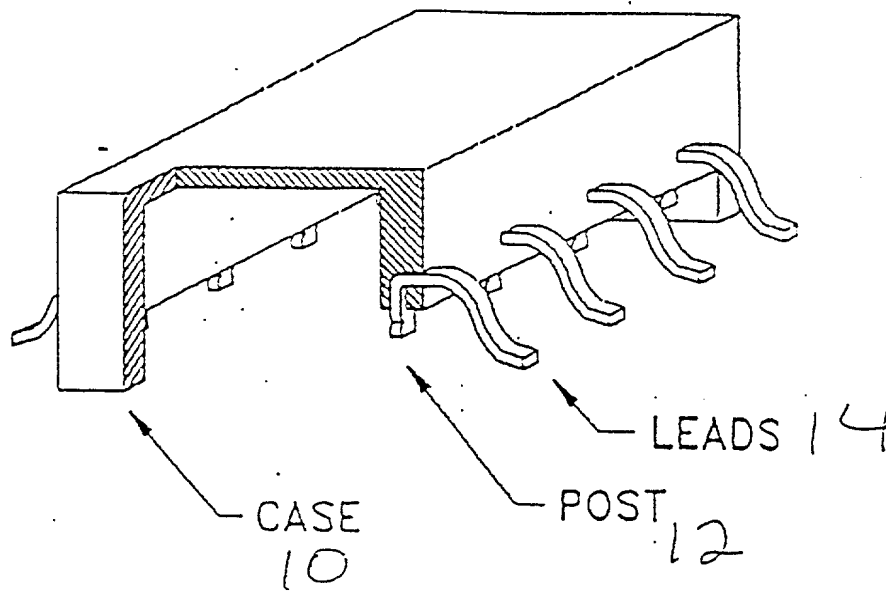


FIGURE 1

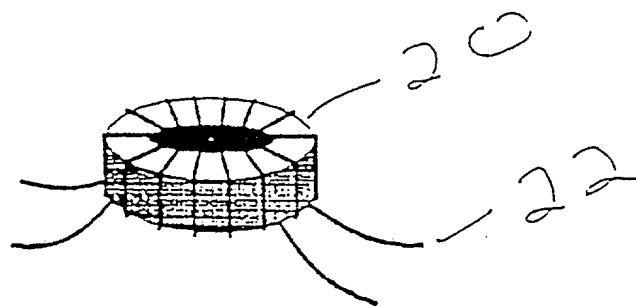


FIGURE 2

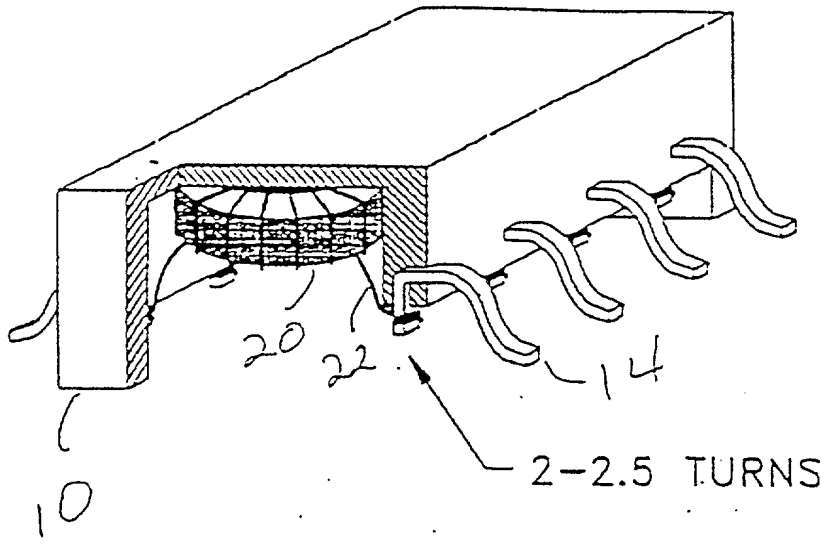


FIGURE 3

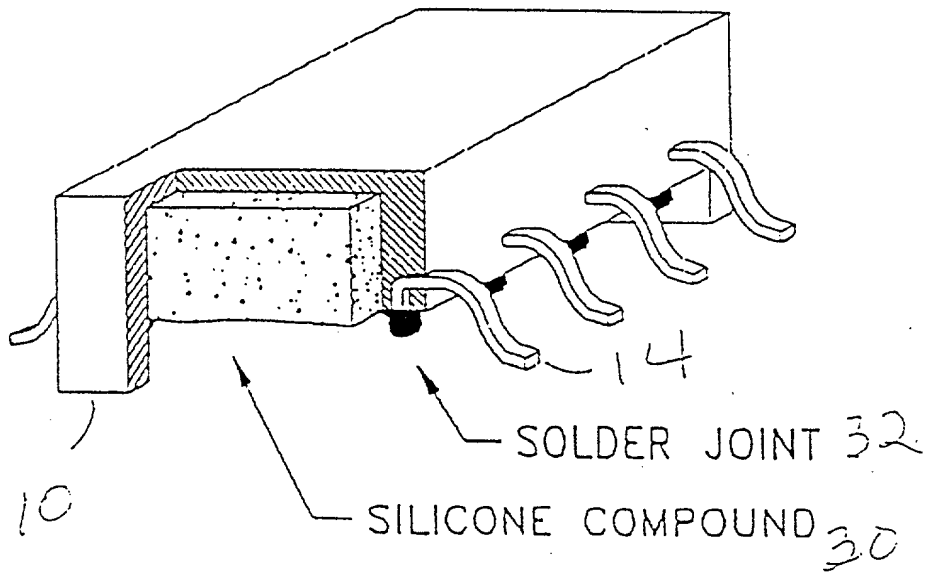


FIGURE 4

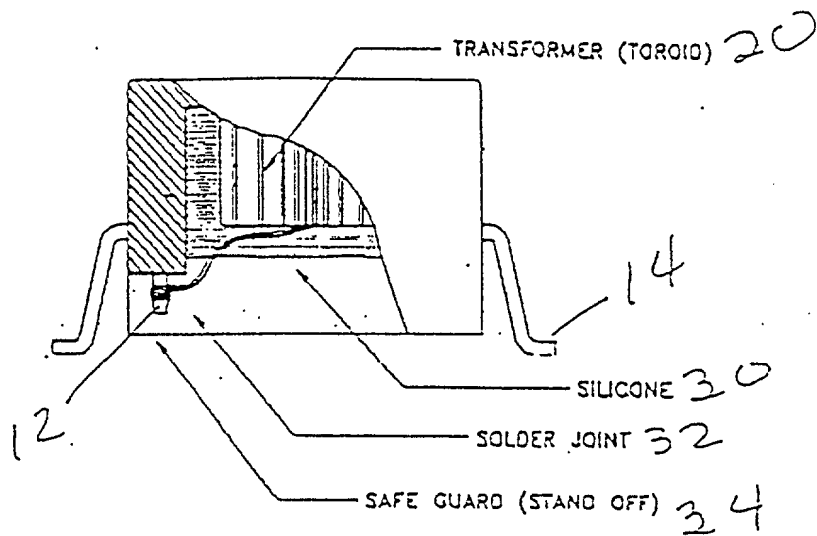


FIGURE 5

CLOSE UP

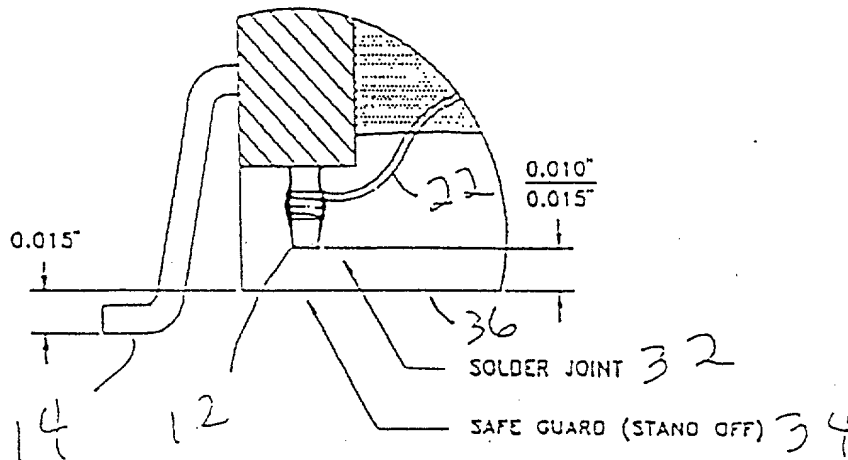


FIGURE 6

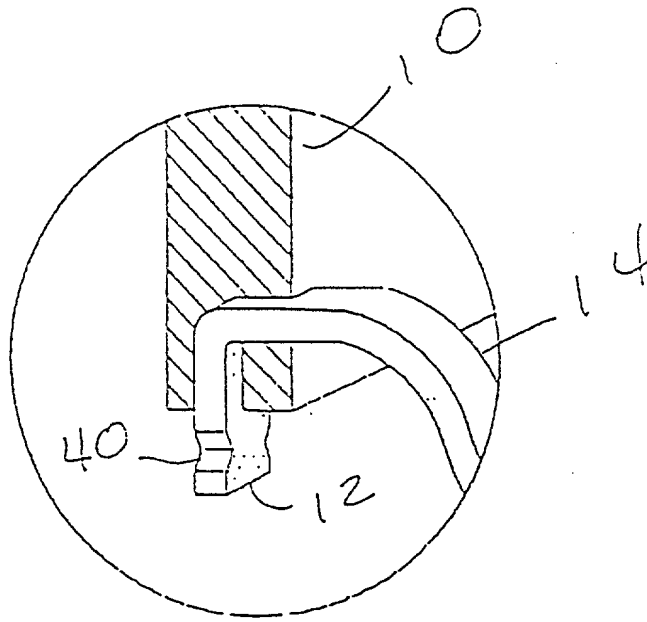


FIGURE 7

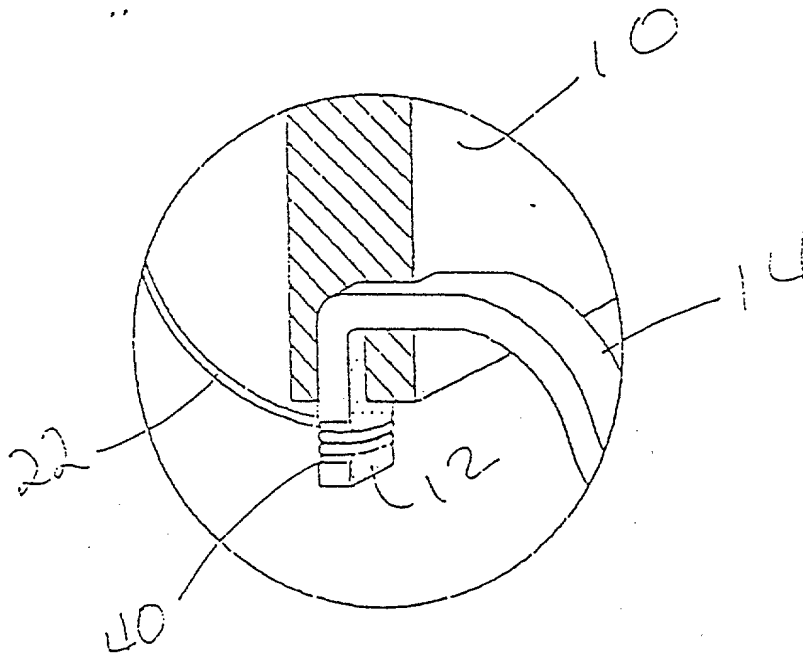


FIGURE 8

SECRET - A

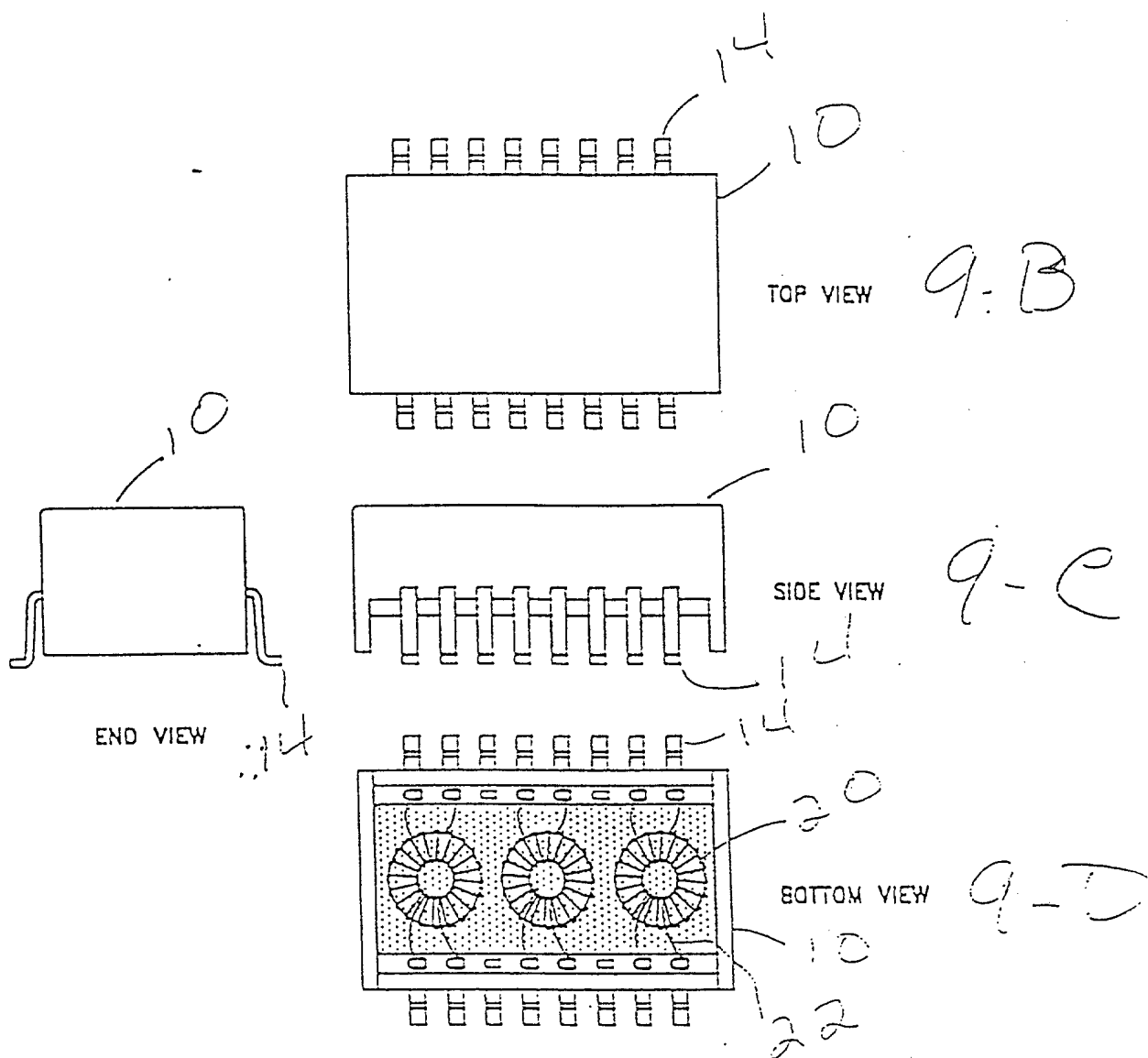


FIGURE 9

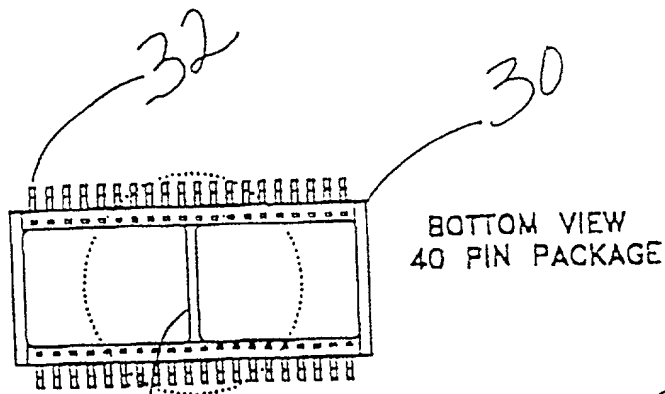
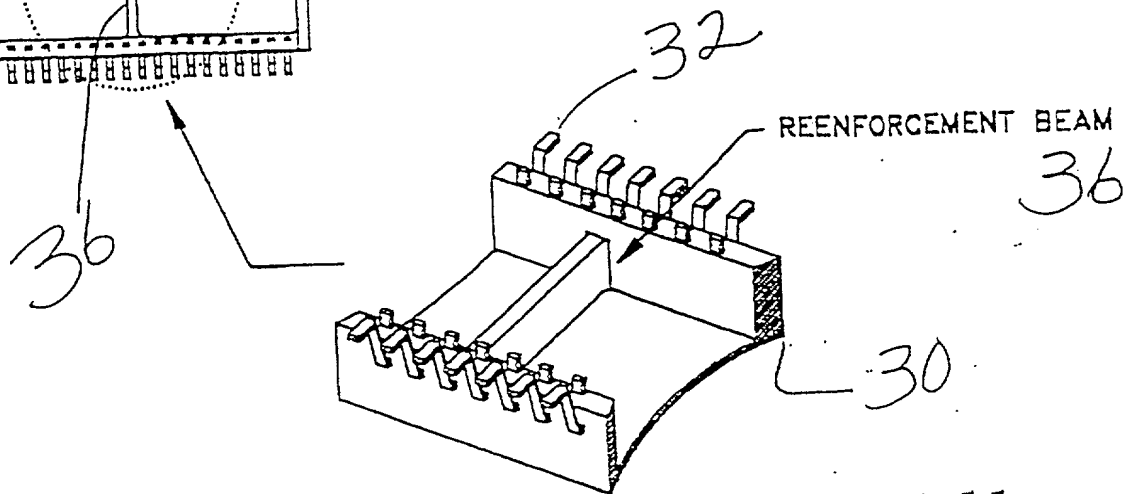


FIGURE 10



ENLARGED
SECTIONAL VIEW

FIGURE 11

HALO 40PIN SURFACE MOUNT PACKAGE INCORPORATES A REINFORCEMENT BEAN WHICH IN TURN PROVIDES EXTRA SUPPORT TO THE MECHANICAL STRENGTH OF THE CASE. IT IS ESSENTIAL TO HAVE A MECHANICALLY STABLE PACKAGE WHEN GOING THROUGH IR RE-FLOW PROCESS AND MAINTAIN THE LEADS CO-PLANARITY.

DECLARATION FOR PATENT APPLICATION

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled ELECTRONIC SURFACE MOUNT PACKAGE, the specification of which:

(check one) ☐ is attached hereto
☒ was filed on 12/27/96 as
Application Serial No.08/773,555
as amended by the Preliminary Amendment
concurrently submitted.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known to me to be material to patentability of this application as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed: (none)

Prior Foreign Application(s)			<u>Priority Claimed</u>	
			<input type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
			<input type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56, which became available between the filing date of the prior application and the national or PCT international filing date of this application:

08/513,573 August 10, 1995 Pending
(Application Serial No.) (Filing Date) (Status)(patented, pending, abandoned)

(Application Serial No.) (Filing Date) (Status)(patented, pending, abandoned)

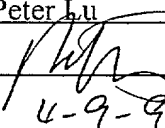
Direct all telephone calls to Stephen E. Baldwin at (415) 324-2258.

Address all correspondence to:

TRIAL & TECHNOLOGY GROUP
A Professional Law Corporation
545 Middlefield Road, Suite 220
Menlo Park, CA 94025

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Title 18, United States Code, §1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: Peter Lu

Inventor's signature: 

Date: 4-9-97

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Citizenship: U. S. Citizen

Post Office Address: 194 Civic Circle Lewisville, TX 75067

Full name of second joint inventor, if any: Jeffrey Heaton

Inventor's signature: 

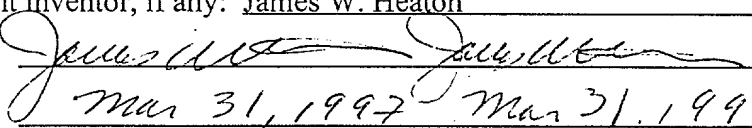
Date: 4-9-97

Residence: 7583 Normandy Way Cupertino, Ca 95014

Citizenship: U. S. Citizen

Post Office Address: same

Full name of third joint inventor, if any: James W. Heaton

Inventor's signature: 

Date: Mar 31, 1997 Mar 31, 1997

Residence: 1963 Fallen Leaf Lane, Los Altos, CA 94024

Citizenship: U.S. Citizen

Post Office Address: same

Full name of fourth joint inventor, if any: Tsang Kei Sun

Inventor's signature: Ts. Kei Sun

Date: APR 7, 1997

Residence: Flat F, 19/F, Tower One, Belvedere Garden, Phase Two,
Tsuen Wan, Kowloon, Hong Kong

Citizenship: Hong Kong

Post Office Address: same

Full name of fifth joint inventor, if any: Peter Loh Hang Pao

Inventor's signature: Peter Loh

Date: APR 7, 97

Residence: 10 Camarvon Road, 8/F, A-1, Kowloon, Hong Kong

Citizenship: China

Post Office Address: same

Full name of sixth joint inventor, if any: Robert Loke Hang Lam

Inventor's signature: Robert Loke

Date: APR. 7. 97

Residence: Flat A, 6/F, Block 3, Wonderland Villas, N.T.,
Kowloon, Hong Kong

Citizenship: Hong Kong

Post Office Address: same